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U. S. FOREST SERVICE BOARD-FOOT LOG SCALING STANDARDS

By
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Ogden, Utah
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DIRECTOR
AND REFER TO

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RE - INT
FOREST SURVEY
Inventory
Log Scales

June 27, 1957

Dear Sir:

The use of differing log scale standards has been a rather annoying problem when coordinating the nationwide forest survey with National Forest Administration's timber management planning inventories. Paul D. Kemp has prepared a statement explaining the problem and presenting a case for the acceptance of a common log rule.

We felt that this statement was of sufficient interest to reproduce as an In-Service Publication. Copies are attached for your information and comment. Additional copies are available.

Very truly yours,

Reed W. Bailey

REED W. BAILEY
Director

Attach.

U. S. FOREST SERVICE BOARD-FOOT LOG SCALING STANDARDS

Paul D. Kemp
Division of Forest Economics

INTRODUCTION

A look at the facts indicates wide discrepancy and even confusion within the Forest Service with regard to the board-foot volume of sawlogs, because there are actually three official log scale standards--Scribner Decimal C, Scribner Formula, and International ¼-inch. The Scribner Decimal C Rule was adopted as the official Forest Service standard about 1905. The Scribner Formula Rule was developed some 30 years ago by Forest Service mensurationists to overcome the shortcomings of the original Scribner Rule, the basis of the Decimal form. By virtue of wide use and acceptance, it has become the "official" Scribner Rule of mensurationists both within and outside the Forest Service. In the 1940 revision (still current) of the National Forest Scaling Handbook, the International ¼-inch Rule was adopted as an optional official standard and the Scribner Decimal C relegated to an optional official status, the choice being left to the various Forest Service Regions.

The International ¼-inch Rule was adopted as the optional standard after extensive tests during the salvage operation of the New England "blowdown" proved it to give estimates closely approximating lumber recovery in modern mill operations. Tests of the Scribner Decimal C Rule made at the same time showed considerable, but not uniform overrun. This confirmed previous experience and the opinion of all mensurationists. Actually, the Scribner Decimal C Rule for many years has not been the official Forest Service standard in a strict sense even when so designated. It has generally been used with "overrun" factors. The usual procedure in applying overrun factors is to either reduce costs or extend returns, but the adjustment is basically an adjustment of volume. Hence, whenever overrun factors are used in stumpage appraisals, the standard scale stick gives an estimate of nominal or preliminary rather than final volume, and under the circumstances, the standard defined in advertized sales is a nominal rather than an actual standard.

Summing up the situation, the Forest Service has three official standards for scaling sawlogs, differing widely in some respects. They are, (1) the International ¼-inch Rule, (2) the Scribner Decimal C Rule, and (3) the Scribner Formula Rule. For example, a 16-foot sawlog 6 inches in diameter by International ¼-inch Rule scales 19 board feet; a lodgepole pine log of the same dimensions by Scribner Decimal C Rule scales 20 feet or 25 feet in Region 1 when extended by customary overrun. By Scribner Formula Rule the same log scales 12 feet. Obviously, such inconsistencies confound direct nationwide comparisons of stumpage prices, logging and milling costs, and complicate and increase the cost of volume computations and management studies.

PROGRESS TOWARD STANDARDIZATION

The adoption of the International ¼-inch Rule as an optional standard in 1940, was actually a retrogression from standardization--number of standards was increased from 2 to 3. However, it was hoped that this standard ultimately would replace the Decimal C Rule and the never-satisfactorily-solved problem of overrun. To date, however, of the 10 Forest Service Regions, only Region 7 has "gone modern." A notable further step forward both within and outside was taken in 1945 by the Forest Service Branch of Research, with the adoption of the International ¼-inch Rule as the official standard for the nationwide Forest Survey. No further progress has been made since that date. The issue has been deadcentered for 10 years. The Chief's office has offered a way out of the dilemma, but the regions with a single exception have been reluctant to take advantage of the opportunity. Within each region mensurationists without exception, and many others, have urged the adoption of the International ¼-inch Rule. But as is frequently the case, those who are best qualified to judge the need for a change have no authority to bring it about. On the other hand, those who have the authority to change either are not clearly convinced of the need or are reluctant to break away from tradition.

The need for a change to a common standard for Forest Survey and Administration is especially urgent in Regions 1 and 2 because of the cooperative inventory programs now under way. The savings in volume and growth computations will at least equal 5 percent of total project cost.

BACKGROUND

The following background information points up the details of the situation:

Board-foot Log Standards

Board-foot log standards are predictions of the average quantity of rectangular-shaped material that can be sectioned from near cylindrical solids of given size under given conditions. They are standards of the converting type that involve large and variable residue factors in contrast with cubic-foot log standards that measure the solid in its existing form. The precision of the latter depends entirely upon the refinement and number of measurements. Numerous variables other than measurement affect the reliability of the former. Cubic- and board-foot standards are somewhat comparable, respectively, to measuring paint (1) by the gallon and (2) by square feet of coverage, or bologna (1) by the pound and (2) by number of slices. These limitations must be borne in mind in gaging logs by board-foot measure.

Specified conditions of board-foot standards are: (1) output is always expressed in 1-inch thick sections with a specified kerf--generally ¼- or 1/8-inch; (2) for some rules, allowance is made for shrinkage, log taper, normal crook, and minimum width and length of section. Obviously output is a fair test of the reliability of a standard only under the specified conditions.

There are many other unspecified factors that materially affect lumber recovery such as (1) type and condition of equipment, (2) skill and care of sawyers and other machine operators, (3) manner of sawing--live, turned, taper, or not taper, (4) in the case of defective logs, the judgment of the scaler, and (5) the minimum merchantable grade of lumber--3 and better or 5 and better.

Overrun

Overrun is defined as "the excess of the amount of lumber actually sawed from logs over the estimated volume or log scale." By this broad interpretation, board-foot log scale is a meaningless term which cannot be defined, hence is not a standard of measurement. The overrun of a specific standard can only be derived by comparing the log scale by that standard with the lumber output produced according to the specifications of that standard. When an operator utilizes part of the waste allowed for in the Scribner Decimal C Rule, i.e., wastes less than ¼-inch kerf, saves some kerfs entirely by cutting dimension, or saves a fraction on each board by sawing 31/32-inch thickness rather than 1-inch, the output is not a fair measure of the overrun of that standard. The standard simply does not fit that type of manufacture.

The importance of overrun could be minimized by setting up a standard for each of the prevailing sawing practices but because of the many variables already discussed, it could never be entirely eliminated nor predicted within probably 5 percent. Overrun can be determined only by actual test and the results of such tests may vary considerably from day to day with the same type of logs in the same mill.

Certainly the customary practice of deriving overrun on Scribner Decimal C Rule by comparing log scale to the nearest full inch diameter class and the nearest 10 board feet, with lumber recovery to the nearest board foot, and applying it as an average flat factor to all log diameter classes will not bear very close scrutiny. The rational procedure with regard to overrun is to avoid it by adopting and sticking to a good log scale standard that comes reasonably close to predicting lumber recovery under average prevailing conditions of milling.

Using overrun factors is poor psychology, implies unwarranted assurance to the average operator, and opens the door to complaints. Its use is also contradictory. On one hand, it is a tacit admission of no confidence in the board-foot log rule and on the other, by the use of uniform overrun factors, it implies an accuracy in the rule itself which it does not have.

Scribner Log Rule

The old Scribner Log Rule was derived by diagramming 1-inch boards with $\frac{1}{4}$-inch kerf on circles, the idealized small end diameter of logs, ranging from 12 to 44 inches. A fourth edition of the Rule was published about 1846. The volumes were not curved over diameter, hence the Rule is actually a composite of a number of standards. There are no minimum specifications. An even cruder extension of the Rule down to 6-inch diameters was made by an unknown author. And about 1905 rational extensions were made by Ziegler of the U. S. Forest Service to cover logs up to 120 inches in diameter.

Scribner Decimal C Rule

The Scribner Decimal C Rule was derived from the original Scribner volumes and extensions by rounding to the nearest 10 board feet. In this form it was adopted about 1905 as the U. S. Forest Service scaling standard. In 1940, it was relegated to an optional official position.

Within the 6- to 44-inch diameter class range, this Rule has all the shortcomings of the original Scribner, compounded in some respects by rounding and errors in rounding. Furthermore, the rounding is not in accordance with approved practices of considering the size of the quantity. Ideally, rounding should be on a percentage rather than a uniform amount basis. There would have been no serious practial limitation if rounding had been limited to logs 14 inches and larger in designing scale sticks.

Scribner Formula Rule

The Scribner Formula Rule was devised by Donald Bruce about 1923 by fitting an equation by least squares to the original Scribner volumes for even-inch diameters from 6 to 40 inches. By this process for the first time the entire range of the Scribner volumes was given scientific respectability, i.e., the Scribner Rule was transformed into a single standard, the basic requirement for a standard of measurement. Expressed in terms of a formula the Scribner Rule for the first time logically could be applied to finer than 1-inch diameter classes. For this reason it was immediately adopted as the Scribner Rule of mensurationists for volume and yield table studies. Percentagewise, differences between the

Scribner Formula and Scribner Decimal C volumes, although notable in individual logs, are negligible in the aggregate for logs 8 inches and larger, but for 6- and 7-inch logs, the Decimal C volumes exceed the Formula volumes by 67 percent. This again confirms the previous checks that the Decimal C Rule overscales the 6- and 7-inch diameter classes in relation to larger diameters.

International ¼-inch Log Rule

The International ¼-inch Log Rule volumes were first published about 1917 by Judson Clark, a renowned authority. They were derived from an earlier version on an 1/8-inch kerf basis developed in 1900 by applying a converting factor of .904762 or approximately .905. The Rule allows ¼-inch kerf plus 1/16-inch shrinkage for each full inch of lumber. Allowance for slabs, edging, and a normal crook up to ½-inch in 4 feet is in the form of a plank equal to 2.12D; expressed in board feet this is equivalent to .71 times diameter for each 4 feet of log. For logs longer than 4 feet the Rule allows for taper at the rate of ½-inch for each 4 feet. Boards less than 3 inches in width and 2 feet in length or containing less than 2 board feet are not considered merchantable, i.e., a board 3 inches in width and less than 8 feet long is considered unmerchantable.

Within the limits that overrun generally can be predicted, board-foot log volumes by this Rule are equivalent to lumber recovery under current average mill practices. In exceptionally efficient mills actual lumber recovery may exceed the Rule predictions up to 10 percent; underruns may on the other hand be expected in efficient mills. There is no perfect rule that fits all conditions. But this rule comes closest to meeting the needs of a common standard.

SOME COMPARISONS ARE MADE

Chart 1 shows the relationship of the Decimal C Rule to the original Scribner, Scribner Formula, and International ¼-inch Rules. The full inch volumes have been connected to facilitate comparison. In scaling by full inch classes, the volumes actually define a series of abrupt step-ups. Table 1, column 6, shows the Scribner Decimal C volumes and column 7 the factors that should be applied to make them equal to International ¼-inch volumes. Only in case of the 25-inch log class are the two standards identical. Adjustment factors range from .94 for 6- and 7-inch logs, which are notoriously overscaled, to 1.30 for 8-inch logs which are notoriously underscaled. Throughout the range there is no well-defined pattern. Column 10 shows that by International ¼-inch standard a flat overrun factor of 25 percent would overscale 6- and 7-inch logs by 32 percent.

Table 2, columns 6, 7, and 8, shows the results of a check by board-foot/cubic-foot ratios on Scribner, Scribner Decimal C, and Scribner Decimal C extended 25 percent. This test is very sensitive. The underscored items indicating irrational decreases in ratios with increases in log diameter, is another proof that no form of the Scribner diagram rule meets the basic requirements of a standard of measurement.

Table 3 compares the actual board-foot differences between International ¼-inch and Scribner Formula, International ¼-inch and Scribner Decimal C, and Scribner Decimal C and Scribner Formula Rules for logs by inch classes from 6 to 25 inches, and by 10-inch classes from 30- to 90-inch logs. Greatest absolute differences occur in logs 30 inches and larger but the relative differences are small, in fact within acceptable scaling limits. Smallest absolute differences occur in 6- to 10-inch logs but the relative differences are high. These data show that the Scribner Decimal C volumes are particularly unrealistic for small logs. In most past sales with merchantable top limits of 8 inches and larger the proportion of total volume in logs below 10 inches was negligible. But there is increasing interest in the milling of lodgepole pine in which the volume in logs below 8 inches may constitute 40 percent or more of the total volume.

Since the Decimal C Rule actually never met the basic requirements of a standard of measure for logs from 6 to 24 inches, why was it adopted as the U. S. Forest Service standard? The answer is that it was the better of two poor log rule choices then in common use. Also, a buyers' market prevailed at the time, sellers had little choice but to fall in line and there was virtually no market for logs under 8 inches in diameter.

THE CASE AGAINST THE SCRIBNER DECIMAL C RULE

Volume for 16-foot logs by Scribner Decimal C Rule are listed in column 6 of table 1 for diameters from 6 to 25 inches and in chart 1 for diameters to 17 inches in comparison with other standards. The statement is commonly made and it is the prevailing belief that the rule underscales small logs more than large logs. Such impressions are correct if 6- and 7-inch logs are excluded from the consideration. This is evident both from the chart and column 7 of table 1 which lists the factors by which volumes by Decimal C must be multiplied to equal International ¼-inch volumes. Actually, 6- and 7-inch logs are overscaled in ordinary scaling practice by 6 percent. Furthermore, if more logs within these groups happened to fall below the mean of their class--6.0 or 7.0 inches--than above, the overscale might be considerably greater. Column 9 shows the Scribner Decimal C volumes extended by 25 percent for overrun, the current

overrun for lodgepole pine in Region 1. On a sale transaction basis the overscale by International ¼-inch volume is 32 percent. Rounding to the nearest 10 board feet is questionable procedure for logs scaling less than 100 board feet. Reference to column 4, table 1, shows that the volume of both 6- and 7-inch logs was rounded upward--only 2 feet in each case but percentagewise respectively 11 and 7 percent.

There is no doubt that the Decimal C scale, compounded by customary overrun, overscales 6- and 7-inch logs. Furthermore, under customary appraisal practices the overscaled volumes are further overpriced by the use of average costs of logging, hauling, milling, etc., and average lumber prices. Small logs invariably cost more to log, haul, and mill than average logs. Quality of lumber from small logs may grade as high as average logs but the lumber includes a higher proportion of narrow stock for which there is limited demand.

To what extent the use of the Decimal C Rule, customary overrun, and appraisal practices has handicapped full utilization of small sawlogs can only be conjecture. But it has undoubtedly contributed to buyers' resistance to small logs and poor housekeeping practices in the woods, has increased brush disposal costs, impeded seedbed preparation, and increased fire danger in cut-over areas.

Use of the Scribner Decimal C Rule almost invariably includes allowance for overrun, but because of the erratic volumes of this standard, overruns by log diameter class are likewise erratic. Hence, to apply overrun correctly requires inventory volumes by log diameter. This information is seldom available. Furthermore, the use of overrun factors is an indirect acknowledgement that the standard itself is unsatisfactory. Use of overrun factors alters the standard itself so that lumber advertised in terms of the Decimal C Rule is actually sold by a materially different and undefined standard.

THE CASE FOR THE INTERNATIONAL ¼-INCH RULE

The International ¼-inch Rule has the endorsement of mensurationists because it is a formula rule that predicts log volumes closely approximating the lumber recovery under average prevailing mill practices. A formula rule is the only type that lends itself readily to close mensurational work. Use of this rule will go far toward abandonment of overrun factors with their attendant evils. Log volumes by this rule generally lie between the volumes by Scribner Decimal C Rule and the lumber recovery of efficient band mills. Generally, they are close enough to lumber recovery that overrun can be ignored.

The adoption of the International ¼-inch Rule as the official standard by all Forest Service organizations would not only result in all the advantages of a common standard in the entire organization, but would be a notable step toward eventual standardization in the United States. There can be no question as to the desirability of one common standard for board-foot volume within the Forest Service. Already, the International ¼-inch Rule is the required board foot standard for the nationwide Forest Survey. The data collected by this project formed the backbone of the TRR inventory data. The fact that the International ¼-inch Rule was used for such a national report as the TRR implies that it was preferred over all others for this purpose. Since it is the required standard for part of the organization and the preferred standard for nationwide reports undertaken by the same organization, it is only logical that it should be the common standard for the entire organization. Large savings in computation cost would result, particularly throughout the West, where joint inventories between Forest Survey and Administration are already in progress, and can be expected to continue in the future.

CONCLUSION

Progress toward standardization of the board-foot volume of sawlogs in the Forest Service has been at a virtual standstill since 1945 when the International ¼-inch Rule was adopted as the standard for the nationwide Forest Survey. Although this rule was designated in 1940 as an optional official rule for the entire Forest Service, because of a reluctance to break away from deeply-rooted tradition, most Forest Service regions still use or purport to use the Scribner Decimal C Rule, a relic of ox and prairie schooner days. Strictly speaking, the Scribner Decimal C Rule actually ceased to be the official log scaling standard many years ago when overrun was injected into the appraisal calculations. For even though overrun ordinarily is used either to reduce costs or extend returns, the basic effect is to extend volume, i.e., modify the standard of log measurement.

Today within the Forest Service there are in effect three official board-foot log scaling standards, all three of which may be in use by personnel quartered in the same building. This "house-divided" situation is especially inefficient in several western states where the Forest Survey and the Administrative branches of two western Forest Service regions are cooperating in a joint inventory of forest resources. The former is required to derive volumes and growth in terms of International ¼-inch; the latter want inventory and growth statistics in terms of the optional Scribner Decimal C Rule. The use of a common standard will reduce volume and growth computations by an estimated 30 to 40 percent and effect estimated savings in total project cost of at least 5 percent. Furthermore, the use of the common standard will greatly facilitate the exchange of supplementary statistical information now and in the future. In these areas at least it will end this board-foot babel and eliminate much of the future need for costly mill-scale studies to determine overrun and the vexing use of overrun in appraisals.

Table 1.--Board-foot volumes of 16-foot logs by indicated log rule and their relationship[1/] to International ¼-inch Rule

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log diameter top i.b.	International ¼-inch[2/]	Scribner Formula[3/]		Old Scribner[4/]		Scribner Decimal C[5/]		Scribner Decimal C[6/] x 1.25		Scribner Decimal C x 1.25 International ¼-inch	International 1/8-inch Scribner Decimal C
Inches	Bd. ft.	Bd.ft.	Ratio[1/]	Bd.ft.	Ratio[1/]	Bd.ft.	Ratio[1/]	Bd.ft.	Ratio[1/]	Percent	Ratio[1/]
6	19	12	1.58	18	1.06	20	.95	25	.76	1.32	1.05
7	28	21	1.33	28	1.00	30	.93	37	.76	1.32	1.03
8	39	31	1.26	32	1.22	30	1.30	38	1.02	.97	1.44
9	51	42	1.21	40	1.28	40	1.28	50	1.02	.98	1.41
10	65	55	1.18	50	1.30	60	1.08	75	.87	1.15	1.19
11	80	70	1.14	65	1.24	70	1.14	87	.92	1.09	1.26
12	97	86	1.13	79	1.23	80	1.21	100	.97	1.03	1.34
13	115	104	1.11	97	1.19	100	1.15	125	.92	1.09	1.27
14	136	123	1.11	114	1.19	110	1.24	138	.99	1.01	1.37
15	157	144	1.09	142	1.11	140	1.12	175	.90	1.11	1.24
16	181	166	1.09	159	1.14	160	1.13	200	.90	1.10	1.25
17	205	189	1.08	185	1.11	180	1.14	225	.91	1.10	1.26
18	232	216	1.07	213	1.09	210	1.10	262	.89	1.13	1.22
19	260	243	1.07	240	1.08	240	1.08	300	.87	1.15	1.19
20	290	272	1.07	280	1.04	280	1.04	350	.83	1.17	1.15
21	321	302	1.06	304	1.06	300	1.07	375	.86	1.17	1.18
22	354	334	1.06	334	1.06	330	1.07	413	.86	1.17	1.18
23	388	368	1.05	377	1.03	380	1.02	475	.82	1.22	1.13
24	424	403	1.05	404	1.05	400	1.06	500	.85	1.18	1.17
25	462	440	1.05	459	1.01	460	1.00	575	.80	1.24	1.10
Totals	3,904	3,621	1.08	3,620	1.08	3,620	1.08	4,525	.86	1.16	1.19
6- 7	47	33	1.42	46	1.02	50	.94	62	.76	1.32	1.04
8- 9	90	73	1.23	72	1.25	70	1.29	88	1.02	.98	1.43
10-13	357	315	1.13	291	1.23	310	1.15	387	.92	1.08	1.27
14-19	1,171	1,081	1.08	1,053	1.11	1,040	1.13	1,300	.90	1.11	1.25
20-25	2,239	2,119	1.06	2,158	1.04	2,150	1.04	2,688	.83	1.20	1.15

1/ The factor by which the appropriate volume must be multiplied to equal International ¼-inch volume, i.e., converting factors assuming International ¼-inch Rule as lumber tally.

2/ $V = 0.796D^2 - 1.375D - 1.230$

3/ $V = .79D^2 - 2D - 4$

4/ From Woodsman's Manual. Carey. 5th Ed., p. 302, there are slight variations in this Rule, depending upon the source.

5/ U. S. Forest Service Form 874-24

6/ Current overrun on Scribner Decimal C Rule for lodgepole pine in Forest Service Region 1 is 25 percent.

Table 2.--Board-foot/cubic-foot relationships for 16.3-foot logs and successive differences by indicated log rules

Log diameter top i.b.	Middle log diameter i.b.[1]	Log volume i.b.[2]	International ¼-inch	Scribner formula	Old Scribner formula	Scribner Decimal C	Scribner Decimal C x 1.25	Successive differences: International ¼-inch	Scribner formula	Old Scribner formula	Scribner Decimal C	Scribner Decimal C x 1.25
Inches	Inches	Cu. ft.	Board feet per cubic foot									
5.0	6.02	3.222	3.72	1.86	4.03	[3]3.10	[3]3.88					
6.0	7.02	4.381	4.34	2.74	4.11	4.57	5.71	.62	.88	.08	1.47	1.83
7.0	8.02	5.718	4.90	3.67	4.90	5.25	6.56	.56	.93	.79	.68	.85
8.0	9.02	7.233	5.39	4.15	4.42	4.15	5.19	.49	.48	-.48	-1.10	-1.37
9.0	10.02	8.926	5.71	4.71	4.48	4.48	5.60	.32	.56	.06	.33	.41
10.0	11.02	10.796	6.02	5.09	4.63	5.56	6.95	.31	.38	.15	1.08	1.35
11.0	12.02	12.845	6.23	5.45	5.06	5.45	6.81	.21	.36	.43	-.11	-.14
12.0	13.02	15.071	6.44	5.71	5.24	5.31	6.64	.21	.26	.18	-.14	-.17
13.0	14.02	17.475	6.58	5.95	5.55	5.72	7.15	.14	.24	.31	.41	.51
14.0	15.02	20.056	6.78	6.13	5.68	5.48	6.85	.20	.18	.13	-.24	-.30
15.0	16.02	22.816	6.88	6.31	6.22	6.14	7.67	.10	.18	.54	.66	.82
16.0	17.02	25.753	7.02	6.45	6.17	6.21	7.77	.14	.14	-.05	.07	.10
17.0	18.02	28.869	7.10	6.55	6.41	6.24	7.79	.08	.10	.24	.03	.02
18.0	19.02	32.161	7.21	6.72	6.62	6.53	8.16	.11	.17	.21	.29	.37
19.0	20.02	35.632	7.30	6.82	6.74	6.74	8.42	.09	.10	.12	.21	.26
20.0	21.02	39.281	7.38	6.92	7.13	7.13	8.91	.08	.10	.39	.39	.49
21.0	22.02	43.107	7.45	7.01	7.05	6.96	8.70	.07	.09	-.08	-.17	-.21
22.0	23.02	47.111	7.51	7.09	7.09	7.00	8.77	.06	.08	.04	.04	.07
23.0	24.02	51.293	7.56	7.17	7.35	7.41	9.26	.05	.08	.26	.41	.49
24.0	25.02	55.653	7.62	7.24	7.26	7.19	8.98	.06	.07	-.09	-.22	-.28
25.0	26.02	60.191	7.68	7.31	7.63	7.64	9.55	.06	.07	.37	.45	.57
Total		544.368						3.97	5.45	3.60	4.54	5.67
Average			7.17	6.65	6.65	6.65	8.31					

1/ Assuming average taper of ½-inch in 4 feet, 1.02 inches in 8.15 feet.

2/ Computed by Huber's formula $V = .0054\ 5154D^2 \times 16.3 = .08890271D^2$.

The underscored items indicate irrational downward trend in board-foot/cubic-foot ratios.

3/ U. S. Forest Service Form 874-24 sets the 6-inch class (5.6 inches) as the minimum for computed board-foot volume. The 10 board feet for the 5-inch class used for comparative purpose is from table 30, "Converting Factors and Tables of Equivalents Used in Forestry." USDA Misc. Pub. No. 225.

Table 3.--Absolute and relative volume differences of 16-foot logs by indicated log rules

Log diameter top i.b.	International-1/4-inch - Scribner formula	Difference / International-1/4-inch	International-1/4-inch - Scribner Decimal C	Difference / International-1/4-inch	Scribner Formula-Scribner Decimal C	Difference / Scribner formula
Inches	Board feet	Ratio	Board feet	Ratio	Board feet	Ratio
5	6	.50	2	.17	-4	-.67
6	7	.37	-1	-.05	-8	-.67
7	7	.25	-2	-.07	-9	-.43
8	8	.21	9	.23	1	.03
9	9	.18	11	.22	2	.05
10	10	.15	5	.08	-5	-.09
11	10	.13	10	.13	0	.00
12	11	.11	17	.18	6	.07
13	11	.10	15	.13	4	.04
14	13	.10	26	.19	13	.11
15	13	.08	17	.11	4	.03
16	15	.08	21	.12	6	.04
17	16	.08	25	.12	9	.05
18	16	.07	22	.09	6	.03
19	17	.07	20	.08	3	.01
20	18	.06	10	.03	-8	-.03
21	19	.06	21	.07	2	.01
22	20	.06	24	.07	4	.01
23	20	.05	8	.02	-12	-.03
24	21	.05	24	.06	3	.01
25	22	.05	2	.004	-20	-.05
Subtotal	289	.074	286	.073	-3	.001
30	27	.04	14	.02	-13	.02
40	37	.03	17	.01	-20	.02
50	49	.03	50	.03	1	neg.
60	62	.02	82	.03	20	.01
70	76	.02	83	.02	7	.002
80	91	.02	43	.01	-48	.01
90	108	.02	33	.01	-75	.01
Subtotal	452	.021	324	.015	-128	.006
Grand total	741	.029	610	.024	-131	.005

Volume (16-foot logs) by indicated log rule

Log diameter top i.b.	International-1/4-inch	Scribner formula	Scribner Decimal C
Inches	Board feet	Board feet	Board feet
30	674	647	660
40	1,217	1,180	1,200
50	1,920	1,871	1,870
60	2,782	2,720	2,700
70	3,803	3,727	3,720
80	4,983	4,892	4,940
90	6,323	6,215	6,290

Table 4.--Scribner Decimal C adjustment factors assuming International ¼-inch and International 1/8-inch as mill tally
(See Chart 2 for graphical presentation)

Log diameter	Scribner Decimal C	International ¼-inch	International ¼-inch / Scribner Decimal C	International 1/8-inch	International 1/8-inch / Scribner Decimal C
Inches	Board feet	Board feet	Board feet	Board feet	Ratio
6	20	19	.95	21	1.05
7	30	28	.93	31	1.03
8	30	39	1.30	43	1.43
9	40	51	1.27	56	1.40
10	60	65	1.08	72	1.20
11	70	80	1.15	88	1.26
12	80	97	1.21	107	1.34
13	100	115	1.15	127	1.27
14	110	136	1.24	150	1.36
15	140	157	1.12	173	1.24
16	160	181	1.13	200	1.25
17	180	205	1.14	227	1.26
18	210	232	1.10	256	1.21
19	240	260	1.08	287	1.20
20	280	290	1.04	320	1.14
21	300	321	1.07	354	1.18
22	330	354	1.07	391	1.18
23	380	388	1.02	429	1.13
24	400	424	1.06	469	1.17
Total	3,160	3,442	1.08	3,801	1.20

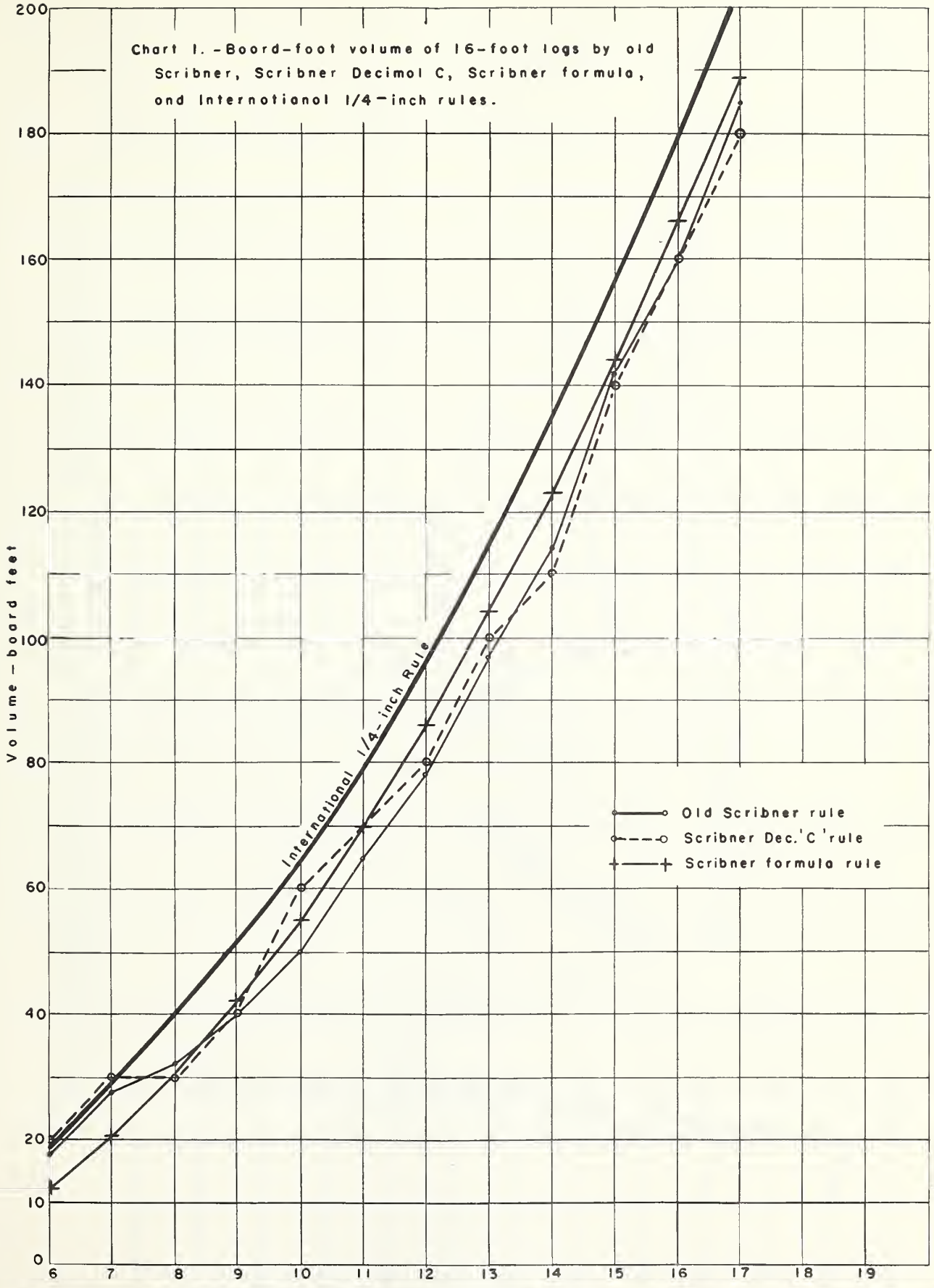
Chart 1. -Boord-foot volume of 16-foot logs by old Scribner, Scribner Decimol C, Scribner formula, ond Internotionol 1/4-inch rules.
Volume - board feet
200
180
160
140
120
100
80
60
40
20
10
0
6
7
8
9
10
11
12
13
14
15
16
17
18
19
International 1/4-inch Rule
Old Scribner rule
Scribner Dec. 'C' rule
Scribner formula rule

Chart 2.— Adjustment factors to convert volume of 16-foot logs scaled by Scribner Decimal C rule to International 1/4-inch rule and International 1/8-inch rule.